

INTRODUCTION

The Northeast Fishery Center presently consists of the Lamar National Fish Hatchery and the Fish Technology Center. Legislative authority for establishing the Fish Hatchery is contained in 46 Statute 371 (White Act), dated May 21, 1930. The station was officially established in 1933 and in the ensuing years has produced and distributed to Federal, State, and private waters, largemouth bass, smallmouth bass, bluegill, catfish, walleye, muskellunge, rainbow trout, brook trout, brown trout, and striped bass. Water to operate the facility is supplied by Washington Spring and Big Fishing Creek. The Fish Hatchery has taken a lead role in supporting the Technology Center programs dealing with Atlantic sturgeon and Atlantic salmon as well as Hatchery Product Evaluation. Production of catchable rainbow trout has been greatly reduced at the Fish Hatchery but a small number are still produced for the annual fishing derby which remains a valuable public outreach program.

The Lamar Fish Cultural Development Center was created in 1965 on the grounds of the Lamar Fish Hatchery. In 1984, the name was changed to the Fish Technology Center and its mission was modified. The mission was again modified in 1993 and current emphasis is on developing new cultural and management technology for threatened and endangered (T&E) aquatic species and species of special concern in the nation's interjurisdictional rivers, and implementing a hatchery product evaluation program. Work at the Center is focused primarily on Atlantic sturgeon and Atlantic salmon, but initial steps toward culture work on fresh water mollusks at the Center have been taken. Local sites were found containing some of the more common mussel species which could be used to develop procedures for working with T&E species.

The Northeast Fishery Center is located 0.5 mile south of Highway 64 on the Tylersville Road in Lamar, Porter Township, Clinton County, Pennsylvania.

Facilities at the Center include an Intensive Culture building for striped bass and sturgeon, an office/hatchery building complex, technology laboratory, coldwater experimental building, maintenance shop, two garages, a fish storage building, twenty concrete raceways, five hypalon-lined earthen ponds, and ten other earthen ponds in need of rehabilitation.

STATION OPERATIONS

Fiscal Year 1994 was consumed by an active and diverse schedule of technology development at the Northeast Fishery Center. The staff took a proactive approach to high priority issues as well as being able to react quickly to other regional fisheries technology needs. Jennifer McPeck, a graduate student at Penn State University was hired as a temporary employee for the summer. In addition, four loyal college student volunteers contributed immensely to this years' successes. Major Center activities in FY94 were as follows:

1. Second year in a row - Captured and spawned adult Hudson River Atlantic sturgeon, Acipenser oxyrhynchus oxyrhynchus, and successfully incubated eggs
2. Completed a second round of Atlantic sturgeon feed trials using first-feeding fry
3. Cooperated with the state of New York to provide 5,000 marked Atlantic sturgeon fingerlings for an experimental stocking in the Hudson River
4. Actively engaged in public outreach/advocacy activities
5. Obtained funding for initial construction of water recirculation capacity at the Intensive Culture building
6. Designed and purchased a low-boy hauling unit for transport of wild Atlantic sturgeon broodstock
7. Hosted a group of visiting Russian sturgeon scientists
8. Served as national coordinator for potassium permanganate as part of the Service's Investigational New Animal Drug (INAD) program
9. Conducted field experiments at other Federal fish hatcheries involving Atlantic salmon egg mortalities
10. Began performing studies to develop fry marking techniques as a tool for better hatchery product evaluation
11. Cooperated with Abernathy Fish Tech Center, Univ. of Calif.- Davis, and NBS - Leetown on fish health issues
12. Served as Regional aquaculture coordinator
13. Provided recreational fishing opportunities

14. Produced two Technical Information Leaflets and the 1993 Proceedings of the Atlantic salmon Workshop
15. Cooperated on a study with the state of Delaware on Atlantic sturgeon mortality
16. Conducted a volunteer program
17. Served on ecosystem management teams
18. Reviewed technical papers
19. Provided culture information worldwide
20. Proposed cooperative agreement with Electric Power Research Institute for studying fluctuating dissolved oxygen levels on Atlantic salmon and sturgeon

Other activities involving the Technology Center are summarized as follows:

"PENNSYLVANIA OUTDOOR LIFE" TELEVISION PROGRAM ON ATLANTIC STURGEON:

A television crew from WNEP studio in the Scranton/Wilkesbarre, Pennsylvania area came to NEFC and interviewed staff biologists for a follow-up documentary about our on-going Atlantic sturgeon culture program. NEFC provided some camcorder footage which WNEP edited into the interview footage. This resulted in a show aired on "Pennsylvania Outdoor Life" in September, 1994. According to program producer Don Jacobs, the viewers responded with enthusiasm about our sturgeon program.

SPAWNING OF HUDSON RIVER ATLANTIC STURGEON:

A ripe, 67 kg female Atlantic sturgeon (total length 220 cm) was captured with a gill net from the Hudson River near Norrie Point State Park, New York on June 26, 1994. The fish was transported approximately 6 hours to NEFC and placed into a maturation tank supplied with fresh flow through water.

Hormone injections of Common Carp Pituitary (CCP) were administered. A primer dose was injected at 10:00 PM, June 26 and was followed by a resolving dose at 11:00 AM, June 27. Approximately 20 hours later, about 100 adhesive eggs were found in the bottom of the maturation tank indicating ovulation had begun. Subsequent surgery resulted in the removal of nearly 260,000 eggs. Eggs were fertilized with pooled milt from 2 mature males captured from the same Hudson River spawning area as the female. Eggs were subject to a variety of handling and incubation conditions in order to improve upon FY93 spawning results.

About 26,000 fry hatched out between July 2 - 4 representing more than a three-fold increase in the percent egg hatch over FY93. Thousands of fry were shipped to NBS-Wellsboro, NBS-Conte lab, and Univ. of Calif.-Davis for diet, behavior, and disease experiments, respectively. A total of 8,000 fry were placed into 4 fertilized ponds to test pond culture using the natural food chain as a starter diet. At the end of 30 days, no survival was found in any of the ponds. About 3,600 fry underwent additional diet trials at NEFC with 6 treatments of formulated and live feeds. The balance of the hatch was raised in a "production mode" with automatic feeding of brine shrimp as the starter diet of choice for the first four weeks of life.

PROFESSIONAL TRAINING ACTIVITIES: Jerre Mohler attended the last Module 2 fisheries training course scheduled to be offered at Leetown, West Virginia.

OPERATION OF CLOSED SALTWATER RECIRCULATION SYSTEM: The 7000 gallon saltwater recirculation system developed in cooperation with Baranaby Whatten of the National Fisheries Research Lab in Wellsboro, PA was operating well through the winter months. In April however, biological conditions became imbalanced in the system which led to the loss of 2 mature sturgeon and two juveniles. It is believed that de-nitrification occurred leading to production of toxins lethal to the fish. A rigorous schedule of system maintenance has since been employed.

FISH FEED INSPECTIONS: As in previous years, the Center has taken responsibility for quality control of production fish diets for Region 5. Quarterly feed inspections were performed by biologist Jerre Mohler and biotechnician Pat Farrell. Only minor quality control problems were encountered during the year. Additionally, the Center voluntarily acts as the clearing house for contract changes the hatcheries need to make on a quarterly basis and collects the invoices for matching to the contract.

INFORMATION DISSEMINATION AND PUBLIC RELATIONS: The Center received and

responded to the following requests for information and other technical assistance during FY93:

1. Bernie Borandi, private individual from Maryland requested information on water reuse systems in sturgeon culture and aquaculture suppliers.
2. Dr. Sree Lakshmi V., India requested information leaflets previously produced at Lamar on Large-scale hatching and decapsulation of brine shrimp.
3. Raymond RaLonde, University of Alaska, requested all available issues of Proceedings of the Atlantic Salmon Workshop and Atlantic Salmon Culture for Restoration manual.
4. Mike Fogarty, private individual from Massachusetts, requested assistance in researching a potential salmonid aquaculture operation.
5. Pyramid Lake Fisheries, a tribal-operated hatchery in Nevada, requested assistance in methods of estimating mortality on eggs of the endangered Cui-ui lake sucker.
6. Reginald Harrell, University of Maryland Extension Service requested information on aquaculture.
7. The State of New York Dept. of Environmental Conservation requested an update on the status of NEFC's FY94 Atlantic sturgeon spawning and incubation for inclusion in their Hudson River Estuary Quarterly publication.
8. Culture information was also provided to 14 individuals in 9 states.

N.P.D.E.S PERMIT COMPLIANCE: The Center is responsible for monthly reporting of flows and various effluent parameters to state and federal agencies for purposes of compliance with the National Pollution Discharge Elimination System permit (N.P.D.E.S.). Water samples from designated discharge points on the facility are taken to a nearby laboratory each month to undergo analysis for: B.O.D., Suspended Solids, Phosphorus, and Ammonium. Monthly reporting forms were completed and sent to the appropriate agencies.

Jerre Mohler and Cathy Johnson prepared and submitted the application for renewal of the Center's N.P.D.E.S. permit.

FIRST ANNUAL CARP RODEO: The reservoir which supplies water to a portion of the facility was drained to facilitate repairs. It was apparent that a carp population was well established there, so a cooperative arrangement was made with the Pennsylvania Game Commission to receive the harvested carp. They plan to utilize the carp as bait in their black bear management program. Three large garbage cans full of carp and suckers were harvested. In addition, the reservoir contained quite a number of wild brown trout some of which were 18" in length. These beauties were relocated below the reservoir into the famous wild brown trout stream, Fishing Creek.

GREAT LAKES FORAGE FISH MEETING: Jerre Mohler attended a meeting at NBS-Cortland field station concerning reintroduction of native deep water sculpin and bloater into Lake Ontario. Introduced alewives and rainbow smelt have most likely led to extirpation of the native forage fish in Lake Ontario. Food resources for reintroduced fish and potential disease problems were two major issues discussed by the group.

FY 94 represented a year of challenge, transition, and success for the Lamar NFH in which the mission shifted from scheduled rainbow trout and striped bass production to that of an integral support unit for Technology Center programs of the NEFC. The decline in trout put-and-take stocking as a federal priority, coupled with the apparent recovery of the Chesapeake's striped bass, and increasing budget and labor constraints made these changes inevitable. With the new mission, hatchery staff have welcomed the increased ability to participate in planning and conduct of Center Technology projects. Also accomplished during FY 94 was extensive participation in outreach programs, in Fisheries Leadership Management System, Service Ecosystem Approach, and continued participation in Service Investigational New Animal Drug Permits.

Distribution for the FY year totaled 111,025 fish and 28,317 pounds a reduction

of 53% and 49% respectively from FY 93 levels. These numbers reflect the initial curtailment of Department of Defence rainbow trout (Sikes' Act) stocking in May 1993 which was followed by the reduction of special event barrier free stocking programs in January 1994. In both instances the hatchery staff explained to former recipients that technology work with endangered, threatened and species of concern as well as interjurisdictional fisheries were Service priorities and that limited funding would be directed to these areas. Alternative sources for fish were also suggested. The effort was generally met with understanding. One Congressional inquiry regarding Carlisle Barracks was received. The number of rainbow trout now supported by the NEFC stands at approximately 2% of FY 92 levels. These fish have been retained to support a highly productive annual outreach fishing program at the Center and as a base pool from which fish for future technology trials may be drawn. Noteworthy among the FY 94 distribution accomplishments was the first ever stocking of cultured Atlantic sturgeon from the Northeast Fishery Center (NEFC) to the river of broodstock origin, the Hudson. Evaluation of the release of the coded wire tagged, fin clipped sturgeon by New York DER may provide population dynamics insights and an indication of hatchery product performance for the species.

Rainbow trout - A total of 29,444 RBT (22,379 lbs.) were distributed in Pennsylvania, Maryland, and New Jersey. Sixty-one percent of the catchable trout were transferred to the Pennsylvania Fish and Boat Commission with the conclusion of scheduled stocking. The efficiency of feed conversion declined from FY 93 levels of 1.55 to 1.72. This drop is attributed to the decline in conversion ability in the older fish now maintained, two and three year old. The total amount of trout weight produced in FY 94 declined by 26,576 pounds to a total of 11,632.

Striped bass - The Nanticoke STB reared in FY 93 and harvested in November, 1993 (FY 94), resulted in a very impressive extensive culture crop 69,331 STB with 72.5% survival and production rates of 31,514 fish and 2,434 lbs. per surface acre - a record weight. Harvest activities with the new fish pump resulted in significantly less stress for both harvesters and harvestees.

Northeast Fishery Center
- Biological Studies Performed -

Fiscal year 1994 developed into a period of intense, diverse, and interesting biological work. Better planning as well as reduced fish production goals and adherence to project study plans earmarked this year as one of commitment to performing better science at the Center. In addition, we made a commitment to devote more time to production of technical bulletins and journal publications. The majority of studies performed by Center biologists and our partners were related to Atlantic sturgeon and Atlantic salmon restoration and are identified as follows:

Study Number and title:

- L-94-01 Diet trials with first-feeding Atlantic sturgeon fry (*Acipenser oxyrhynchus*)

- L-94-02 Implantation and retention of half-length coded wire tags in Atlantic salmon (*Salmo salar*) sac-fry

- L-94-03 Evaluation of tagging procedures and associated tag retention in hatchery-produced yearling Atlantic sturgeon (*Acipenser oxyrhynchus*)

- L-94-04 Growth and survival of 60-day old Atlantic sturgeon (*Acipenser oxyrhynchus*) receiving pelvic fin removal

- L-94-05 Growth comparison of yearling Atlantic sturgeon to evaluate cost-effectiveness utilizing two commercial diets

- L-94-06 Survival of captive juvenile Atlantic sturgeon receiving pectoral spine notch

- L-94-07 Evaluation of eyeup vs. numbers of Atlantic salmon eggs shipped from Berkshire NFH and Cronin NSS for incubation at White River NFH

- L-94-08 Evaluation of Transportation Methods for Green Atlantic Salmon Eggs

- L-94-09 Annotated Bibliography on Marking and Tagging Fry

- L-94-10 Proceedings of the Atlantic salmon workshop - Rockport, Maine; 1993

- L-94-11 Effects of temp., deadhesion, and disinfection techniques on incubation of Atlantic sturgeon (*Acipenser oxyrhinchus*) eggs.

- L-95-02 Comparison of eye-up between green Atlantic salmon (*Salmo salar*) eggs transported to incubation facilities unfertilized with those fertilized prior to transport

- L-95-03 Comparison of use of LHRHa and CCP for synchronization of gonadal development in Atlantic Salmon (*Salmo salar*).

STUDIES IN WHICH THE CENTER COOPERATED:

Immunomodulators as a fish health management tool (*Abernathy Technology Center*)

Growth of sub-yearling Atlantic sturgeon at different temperatures and feed rates (*Jennifer McPeck, Penn State University*)

Carp Pituitary Hormone Injection of Atlantic Salmon in a net pen aquaculture operation (*Kennebec Aquaculture*)

Sex identification of Atlantic sturgeon through molecular techniques (*Richard Brandon, Carl Batt; Cornell University*)

Monitoring stress responses on the reproductive physiology of Atlantic sturgeon
(*William F. Krise, NBS-Wellsboro*)

Study Number and title:

L-94-01 Diet trials with first-feeding Atlantic sturgeon fry (*Acipenser oxyrinchus*)

Principal Investigator: Jerre W. Mohler; Northeast Fishery Center

Co-Invest/Cooperators: Mike Hendrix, Bill Fletcher, Patrick Farrell - NEFC;
Rick Barrows - Bozeman FTC

Background and Justification:

Commercial records of Atlantic sturgeon landings from the late 1800's to the present indicate a severe decline in the fishery (Taub, 1990). The Atlantic States Marine Fisheries Commission (ASMFC) recommended formation of a culture and stocking group to develop guidelines for culture and restoration activities for ensuring consistency with goals and objectives of the ASMFC's Fishery Management Plan for Atlantic Sturgeon, November, 1990.

Previously, limited induced spawning success and short-term culture of this species has precluded most attempts at discovery of acceptable starter diets for first-feeding Atlantic sturgeon fry. A successfully formulated starter diet has not yet been identified for this species. Knowledge gained from this study will be beneficial to future restoration efforts and Atlantic sturgeon management.

Study Objectives:

1. To test six diets to determine their efficacy for conversion of Atlantic sturgeon fry from non-feeding to exogenous feeding over 30 days as measured by survival and weight gain.

Materials and Methods:

- Fry from Atlantic sturgeon eggs incubated at NEFC will be used in diet trials. Fry from incubation trials of 24°C will be randomly selected for trials at the Northeast Fishery Center.
- Two Hundred fry will be placed in each of eighteen 60-liter circular polystyrene tanks.

Diet descriptions: (1) Live Brine Shrimp (2) Live brine Shrimp with Argent Hatchfry supplement (3) Argent Hatchfry Encapsulated diet (4) Bozeman Sturgeon Starter (5) ASD/liver mix (6) Nelson Silver cup semi-moist starter

-Trials will consist of 3 repetitions of 6 different diets described above.

-Feeding rate for formulated feed will be maintained at 10% body weight for trial duration of 30 days. Feed rate for brine shrimp will be to satiation as determined by observation of uneaten organisms on tank bottoms.

- Water source will be heated (approx. 18°C), degassed water from Lamar's Washington Spring.
- Data collected on each treatment will be analyzed using a 1-way ANOVA and any differences between means will be determined using Tukey's HSD Test. The level of significance used in all statistical test will be 5%.

Results

1. Fry survival was less than 28% for all formulated diets offered.
2. Fry survival was 80% or more for all brine shrimp treatments.
3. Fry converted from live brine shrimp to a formulated diet (Biokyowa) after 14 days with no significant mortality.
4. Fry grazed for food on vertically oriented surfaces in culture tanks.

Study Number and Title:

**L-94-02 Implantation and retention of half-length coded wire tags in
Atlantic salmon (*Salmo salar*) sac-fry**

Principal Investigator: Jerre W. Mohler; Northeast Fishery Center (NEFC)

Co-Invest/Cooperators: Mike Hendrix, Bill Fletcher - NEFC; Dave Blick -
Allegheny National Fish Hatchery

Introduction

Release of non-feeding Atlantic salmon fry by the U.S. Fish and Wildlife Service (Service) has become an increasingly important part of the Atlantic salmon restoration program in the Northeastern United States (Region 5). A need exists within Region 5 for a technique of marking Atlantic salmon sac-fry with a readily detectable tag capable of being retained in returning adult fish.

In this pilot study, half-length coded wire tags (CWT) were inserted into snouts of Atlantic salmon sac-fry. A study by Kaill et al. (1990) showed tag retention rates as high as 83.6 - 86.3% in pink salmon from fry release to adult return.

Objectives

Study objectives were to determine the feasibility of tagging Atlantic salmon sac-fry with half-length CWT concerning tag placement, retention, associated mortality, and efficiency of methods.

Methods

Fry were sample weighed prior to tagging. A Northwest Marine Technologies, Mk 3 model CWT machine equipped with a freshly honed insertion needle was adjusted to implant half-length coded wire tags (0.6mm x 0.24mm). We used two commercially available Northwest Marine Technology (Shaw Island, Washington) head molds designed for pacific salmonids: pink salmon fry (2000/lb; 0.23g/fish) and coho salmon fry size (1100/lb; 0.41g/fish). Head molds were modified with epoxy resin and a small grinding tool to accommodate our fish since no mold was commercially available for Atlantic salmon sac fry (3400/lb; 0.13g/fish).

Trials consisted of six different taggers injecting 20 fry each and three groups of 20 control fry (N=180). Fish from three taggers (n=60) were sacrificed the day after tagging for examination under a dissecting microscope to score tag placement and note obvious tissue damage.

Results

1. It was found that taggers spent approximately 20 minutes tagging 20 fry due to difficulties in handling and positioning individual fish of this size.
2. Out of 20 fry, the greatest number successfully tagged by a worker was 16 while the least successful tagger had eight.
3. Total fry which received detectable tags was 62.5% or 75 out of 120.
4. Mortality after 14 days was greatest in "tag-rejected" fish (86.7%) and lowest in controls (75.0%).
5. After 20 days, tag retention was poor in the 10 survivors of the "tagged" group, with only 50% (5 fry) retaining tags.
6. Tag diameter was 0.24mm and needle diameter was 0.54mm. Available target area of snout cartilage in fish was 0.88mm laterally and 0.50mm dorso-ventrally.
7. Tag placement was inconsistent. It was found that 32% of the fish examined sustained potentially lethal injuries and only 18% were properly tagged, i.e., tag horizontal in snout cartilage with no obvious injuries.
8. Seven out of 60 (12%) of fish examined had tags which went undetected.

Study Number and Title:

L-94-03 Evaluation of tagging procedures and associated tag retention in hatchery-produced yearling Atlantic sturgeon (*Acipenser oxyrhynchus*)

Principal Investigator: Jerre W. Mohler; Northeast Fishery Center (NEFC)

Co-Invest/Cooperators: Mike Hendrix, Bill Fletcher - NEFC; Jorgen Skeveland - Maryland Fisheries Resources Office

Background and Justification:

The Atlantic States Marine Fisheries Commission (ASMFC) recommended formation of a culture and stocking group to develop guidelines for culture and restoration activities to ensure consistency with the goals and objectives of the ASMFC's Fishery Management Plan for Atlantic Sturgeon, November, 1990. The culture and stocking group, which is comprised of all ASMFC states, the U.S. Fish and Wildlife Service, and the National Marine Fisheries Service, has made various recommendations including monitoring effectiveness of restoration programs through tagging of all stocked fish. Agencies involved with sturgeon culture and research should develop long-term marking/tagging procedures likely to provide information on individual fish for up to 20 years (Smith, 1992).

As a result of a successful hatchery spawning attempt in 1993, the Northeast Fishery Center at Lamar, Pennsylvania currently maintains approximately 525 yearling sturgeon, some of which are proposed for use in this tag evaluation/retention study.

Study Objectives:

Tag retention and effects on health and growth will be studied. Three tag types and a leading edge pectoral fin notch on hatchery-raised yearling Atlantic sturgeon will be analyzed over an indefinite period of years dictated by retention time of this domestic stock in captivity. An interim analysis will be performed one year from study inception.

Materials and Methods:

The study will take place at NEFC, Lamar, Pa. Tag types/marks and placement locations proposed are: (1) Carlin tag attached to base of the dorsal fin (2) Floy T-bar anchor tag to base of dorsal fin (3) Stainless steel coded wire tag in snout, and (4) under the first dorsal scute (5) removal of small portion of leading edge of pectoral fin.

Sixty fish will be subject to each treatment described above for a total of 300. A control group of approximately 60 fish will remain untreated. Fish will be examined bi-weekly for the first 60 days for tag retention and condition of tag wound area. Examinations will be performed monthly thereafter for study duration. All raceways will receive a prophylactic 50-pound salt treatment daily during the first week of the study.

At the end of one and two years, tag retention, average weight, and length will be compared using one-way analysis of variance. Significance between individual treatments will be tested with Tukey's HSD test. SAS statistical software will be employed for these analyses.

Preliminary Results (after 6 months):

1. Best retention (100%) was seen in CWT placed under the first dorsal scute.
2. Poorest retention (93%) was shown by T-bar floy tags.
3. There was 100% survival in the group with pectoral fin notch.
4. There was no apparent difference in growth between treatments.

Study Number and Title:

L-94-04 Growth and survival of 60-day old Atlantic sturgeon (*Acipenser oxyrinchus*) receiving pelvic fin removal

Principal Investigator: Jerre W. Mohler; Northeast Fishery Center (NEFC)

Co-Invest/Cooperators: Mike Hendrix, Bill Fletcher, Pat Farrell - NEFC

Background and Justification:

Commercial records of Atlantic sturgeon landings from the late 1800's to the present indicate a severe decline in the fishery (Taub, 1990). This problem has been addressed in the form of management plans for restoration of this species throughout its range by the Atlantic States Marine Fisheries Commission (ASMFC). The ASMFC recommended formation of a culture and stocking group to develop guidelines for culture and restoration activities to ensure consistency with the goals and objectives of the ASMFC's Fishery Management Plan for Atlantic Sturgeon, November, 1990. The culture and stocking group has made various recommendations including monitoring effectiveness of restoration programs through tagging of all stocked fish. In addition, a draft protocol for Artificial culture and stocking of Atlantic sturgeon (1994), states that evaluation of the effectiveness of stocking for sturgeon population enhancement is essential. Therefore, placing a readily recognizable mark on released is sturgeon is desirable.

In 1994, the Northeast Fishery Center at Lamar, Pennsylvania was able to spawn a wild Hudson River female which resulted in approximately 5,000 fry surviving 60-days post hatch having an average length of approximately 30 mm and weight of 1.5 grams. Placing commonly used visible tags (eg. floy, carlin, etc.) on fish of this size is judged inappropriate due to the amount of growth which would occur until fish reach sexual maturity and return to spawn. An alternative, permanent external mark such as a fin clip in conjunction with a coded wire tag insert would be desirable.

Study Objectives:

Growth and survival as well as fin regeneration will be studied in 90-day old Atlantic sturgeon receiving a pelvic fin removal over a 30-day period. Secondarily, long term effects of pelvic fin removal will be observed.

Materials and Methods:

The study will take place at NEFC, Lamar, Pa. Removal of one pelvic fin will be performed by anesthetizing fish and clipping with surgical scissors. Sixty fish will be subject to the treatment described above using three replicates of twenty fish. A control group of approximately 60 fish will be anesthetized and handled but remain untreated otherwise. Prior to placement into 60-l circular tanks, weight and average length will be determined for each group. After treatment is received, each group will be fed at the same feed rate (5% body weight/day). Fish will be examined at the end of 30 days for growth and mortalities will be recorded daily. Condition of pelvic clip area will be recorded at the end of the study. At the end of the study average weight, length, and mortality will be compared using one-way analysis of variance. Significance between individual treatments will be tested with Tukey's HSD test. SAS statistical software will be employed for these analyses.

Results:

1. There was no difference in mortality between clipped and control groups.
2. Varying degrees of fin regeneration were observed. Fish which were properly clipped showed no regeneration.

Study Number and Title:

L-94-05 Growth comparison of yearling Atlantic sturgeon to evaluate cost-effectiveness utilizing two commercial diets

Principal Investigators: Kim King - Lock Haven University; Pat Farrell -
Northeast Fishery Center (NEFC)

Co-Investigators/Cooperators: Jerre W. Mohler - NEFC

Background and Justification:

A rapid decline in the Atlantic sturgeon (ASN) population in recent years has led the U.S. Fish and Wildlife Service to investigate aquaculture techniques for the species, to evaluate the potential for stock restoration/enhancement through the release of cultured fish. Two successful spawns in as many years at NEFC have shown that progress is being made on culture of the species. A previous diet study at NEFC identified commercial Biokyowa feed to facilitate greater growth than three other formulated diets when tested on hatchery-produced fingerling ASN. The discovery of a cost-effective grower and maintenance diet for hatchery-produced ASN which could be used as broodstock or for release is important to restoration efforts. Presently, the cost of Biokyowa is over \$6.00/lb while government contract trout diet is procured at approximately \$0.30/lb.

Objectives:

This study will evaluate growth and feed conversion in yearling ASN to determine the cost-effectiveness of using government contract trout diet vs. commercially available Biokyowa feed.

Materials and Methods:

The study will take place at NEFC - Lamar, PA over a 60-day trial period. Feed types to be used are: (1) Biokyowa C-2000/3000 (Biokyowa Inc. - Chesterfield, MO) (2) U.S. Govt contract GR6-30 #3 trout diet (Zeigler Bros., Inc. - Gardners, PA). Weight and length of individual fish will be determined from 84 hatchery-reared yearling ASN prior to random placement into 6 circular culture tanks (6-ft. diameter) each containing 14 fish. Biomass will be adjusted within 5% for each replicate which will be supplied with fresh, flow through, ambient temperature water from Lamar's Washington Spring. Feed rate will be 1% body weight/day administered by automatic feeders. Bi-weekly inventories will be conducted to adjust feed amounts during the study. At the end of 60 days, mean weights and lengths will be compared between treatments using Student's t-test.

Results:

1. ASN had significantly greater weight gain on biokyowa vs. trout diet.
2. Mean cost of producing one kilogram of sturgeon with trout diet was \$1.62 vs. \$17.01 with biokyowa.

Study Number and Title:

L-94-06 Survival of captive juvenile Atlantic sturgeon receiving a pectoral spine notch

Principal Investigator: Cathy Johnson - Northeast Fishery Center (NEFC)

Co-Investigators/Cooperators: Bill Fletcher, Mike Hendrix - NEFC; Jorgen Skeveland - Maryland Office of Fishery Resources; Craig Shirey - Delaware State Dept. of Natural Resources (DNR)

Background and Justification:

Due to a severe decline in Atlantic sturgeon populations, the Atlantic States Marine Fisheries Commission began development of a management plan for the species in 1988 to effect better coastwide management throughout it's range. One of the management objectives is to improve knowledge of the Atlantic sturgeon stock and recommendations were made to establish tagging projects to determine age and growth among other parameters.

During field work, the currently performed non-lethal process for determining sturgeon age is removal of a section of the leading edge of pectoral fin spine and polishing the cross section to make growth annuli readable. A section of spine is commonly removed with a hacksaw and the fish is released back into the wild after topical treatment of the wound with an iodine solution. It is unknown whether this process causes mortality.

Objectives:

The study objective is to determine if removal of a section of pectoral fin spine in captive Atlantic sturgeon juveniles causes mortality.

Methods and Materials:

Sixteen juvenile Atlantic sturgeon (87 - 123cm total length) will be provided to NEFC from the Delaware River by the Delaware DNR. Fish will be held in fresh flow through water at NEFC for a period of time prior to study initiation. All study fish will be anesthetized with MS-222 and randomly selected for being either fin notched or control. Fish will be floy tagged, measured, and weighed as part of the handling process. Fish selected for fin notching will have a one-half inch segment of the leading edge of the pectoral fin spine removed with a hacksaw. Topical treatment of the wound with Betadine solution will follow. Study fish will be released into a half acre hypalon-lined pond and offered pelletized food during the 60-day study but otherwise remain undisturbed.

Results:

1. No mortality occurred in notched or control fish during the study.
2. Pectoral notches were in advanced stages of healing with no apparent lesions or disease in study fish.
3. Weight changes in study fish indicated very little or no feeding occurred.

Study Number and Title:

L-94-07 Evaluation of eyeup vs. numbers of Atlantic salmon eggs shipped from Berkshire NFH and Cronin NSS for incubation at White River NFH

Principle investigator: Jerre W. Mohler - Northeast Fishery Center

Co-Invest/Cooperators: Bruce Jensen - White River National Fish Hatchery

Background and Justification

The U.S. Fish and Wildlife Service Region 5 Hatchery Product Evaluation Program document produced by the Northeast Fishery Center at Lamar, PA identified various evaluations needed to improve restoration efforts for Atlantic salmon. Poor egg eye-up percentages and concomitant failure to attain fry production goals motivated studies between 1989 and 1992 to evaluate the problem at receiving stations. Among those studies, tests were undertaken to evaluate impact of calcium in water hardening, sperm enhancers, and timing of spawn with LHRHa. Pilot studies performed by NEFC biologists in 1993-94 indicate that transport conditions may heavily influence egg eye-up percentages.

Objectives

Percent eye-up of Atlantic salmon eggs shipped to White River NFH from Berkshire NFH and Cronin NSS in 1993 will be tested for correlation to numbers of eggs shipped, dates of shipment, and lot designation of eggs.

Methods and Materials

Data will be supplied by White River NFH concerning numbers of eggs shipped, date of shipment, lot designations, and ultimate percent eye-up of egg shipments from Berkshire NFH and Cronin NSS. These data will be incorporated into a SAS (statistical package) data set and analyzed for correlations between variables. Probability value of 0.05 or less along with proper correlation coefficient will infer a relationship between variables.

Results

1. Numbers of eggs per shipment from Berkshire NFH and Cronin NSS was not a factor in percent eye-up. The correlation was poor.
2. No correlation patterns were evident when percent eye-up was plotted vs. date of shipment for Cronin NSS eggs.
3. Berkshire NFH eggs appeared to have lower percent eye-up when shipped at later dates, but one late shipment included a lot which did poorly even when shipped at an early date.

Study Number and Title:

L-94-08 Evaluation of Transportation Methods for Green Atlantic Salmon Eggs

Principal Investigator: Bill Fletcher - Northeast Fishery Center (NEFC), Lamar

Co-Invest/Cooperators: U.S. Fish and Wildlife Service: Mike Hendrix/Jerre Mohler - NEFC; Ted Meyers and Mary Moore - Connecticut River Coordinator; Mickey Novak - Richard Cronin NSS; Tom Nelson and Bruce Jensen - White River NFH; National Biological Survey: Bill Krise - Wellsboro; State of Connecticut: Steve Gephard - Department of Environ. Protection, Division of Marine Fisheries, and Al Sonski - Kensington Atlantic Salmon Hatchery.

Justification and Background

The Atlantic Salmon Program relies heavily upon fish cultural facilities to produce fry, parr, and smolts for restoration stocking. In practice, many of the production eggs are spawned at one station and transported for incubation at another hatchery. Eye-ups for Atlantic salmon eggs, transported green and fertilized in gallon jugs, have reached levels exceeding 90 percent; however, in recent years eye-ups have been lower, at times below 60 percent. The Atlantic Salmon Program has recently placed an increasing emphasis upon fry stocking as a restoration tool; this has led to increased demand for quality eggs. Since 1989, the Northeast Fishery Center and other U.S. Fish and Wildlife facilities have conducted a number of studies with the aim of improving egg quality.

Objectives

The objective of the present study is to test the effects of different green egg transportation methods upon eye-up. Specifically, the effects of water hardening in iodophor with, or without ice, and time delay between egg take and placement in incubator vs. temperature. These will be tested for eggs from sea-run Atlantic salmon broodstock. Additionally, water hardening in iodophor with, or without ice, and the effects of different egg transport containers will be evaluated for captive Atlantic salmon broodstock.

Methods and Materials

An NEFC spawning team will coordinate spawning dates and incubation with Richard S. Cronin National Salmon Station (NSS) (sea-run broodstock), Kensington Atlantic Salmon Hatchery (captive broodstock), and White River National Fish Hatchery (NFH) (egg incubation site). Spawning will be at a 1:1 female to male ratio. Approximately two pair at Cronin (7,200 eggs total for 8 trials with 3 replications each) and 25 pair of Kensington broodstock (117,000 eggs total for 6 trials with 3 replications each) will be utilized. Two ml of milt per take will be utilized to conduct dry fertilization. Each trial will receive a composite of eggs from each spawn. As a standard practice, gallon jugs represent the primary shipping container; however, one Kensington trial will utilize an egg shipping box and another trial will consist of gamete shipment in oxygenated plastic bags for fertilization at White River NFH (delayed fertilization). One hundred grams of ice will be added to gallon jugs slated for cooling; two trials from Kensington will receive 600 grams ice each. Eggs from Cronin NSS will be placed in incubators at three time intervals - 4, 8, and 12 hours. Incubation data collected by White River NFH will include: initial egg mortality, percent eye-up, prophylactic treatments; and percent hatch, and percent crippled fry. Results of all tests will be analyzed by analyses of variance.

Results

1. Kensington eggs which underwent delayed fertilization had significantly greater eyeup than other treatments ($P=0.05$).
2. Cronin eggs transported with ice had significantly greater eye-up than those transported without ice ($P=0.05$).
3. There was significantly greater percent eye-up in Cronin eggs transported for 4 hours vs. 8 or 12 hours.
4. Iodophor use had no effect on percent eye-up of Atlantic salmon eggs

Study Number and Title:

L-94-09 Annotated bibliography on marking and tagging fry

Principle Investigator: Kim King - Lock Haven University

Co-Invest/Cooperators: NEFC biologists, NBS-Office of Info. Transfer, CO.

Justification and Background

Stocks of Atlantic salmon (*Salmo salar*) have dramatically declined in New England rivers due to overfishing, dam construction, and degradation of spawning and rearing habitats. Since the late 19th century, federal and state agencies have been involved in restoring self-sustaining populations of the species to native waters. In recent years, emphasis has been placed on stocking fry rather than parr or smolts, and is viewed as an important management technique for the species. This shift has led to intense fry tagging efforts by research and management biologists. Therefore, in order to meet current management needs, a viable marking system is needed to obtain credible information on stock contribution, migration, growth, survival, and population estimates. In support of these efforts, this bibliography has been prepared to provide information on potential fry tagging methods available for Atlantic salmon.

Objectives

Study objectives are: (1) To provide fishery biologists and resources managers an overview of sources that can be used to make informed decisions on marking and tagging fry (2) To aid in the development of non-lethal batch marks for fry (3) To aid in development of marking and tagging fry with subsequent non-lethal methods of mark detection.

Materials and Methods

A literature search on tagging methods was performed through the National Biological Survey Information Transfer Center in Fort Collins, Colorado. Through this search, 721 citations were obtained using keywords: marking, tagging, salmon, and trout. This list was narrowed to 130 articles directly pertaining to tagging methods and was further reduced to 16 citations relevant to marking and tagging fry. An additional 21 articles were obtained through cross references. To date, 30 articles have been acquired for interpretation.

Results

1. A total of six different techniques were found for marking fry.
2. Out of 30 articles reviewed, 60% were chemical or elemental marks, 27% were external tags and marks, and 13% were internal marks.

Study Number and Title:

L-94-11 Effects of temperature, deadhesion, and disinfection techniques on hatchery incubation of Atlantic sturgeon (*Acipenser oxyrinchus*) eggs.

Principal Investigator: Jerre W. Mohler - Northeast Fishery Center (NEFC)
Co-Investigators/Cooperators: NEFC biologists

Background and Justification:

Commercial records of Atlantic sturgeon landings from the late 1800's to the present indicate a severe decline in the fishery (Taub, 1990). This problem has been addressed in the form of management plans for restoration of this species throughout its range by the Atlantic States Marine Fisheries Commission (ASMFC). The ASMFC recommended formation of a culture and stocking group to develop guidelines for culture and restoration activities for ensuring consistency with goals and objectives of the ASMFC's Fishery Management Plan for Atlantic Sturgeon, November, 1990. The culture and stocking group, which is comprised of all ASMFC states, the U.S. Fish and Wildlife Service, and the National Marine Fisheries Service, has made various recommendations including research and development on aquaculture. Basic cultural experiments should be undertaken at appropriate federal and state facilities to provide information onegg incubation and fry production techniques... (Smith, 1992).

Study Objectives:

Objectives are to compare the percent hatch of hatchery-spawned Atlantic sturgeon eggs over a one week period using variables of temperature, deadhesion technique, and disinfection technique as part of the incubation process. In addition, immediate vs. 24-hr delayed fertilization will be compared for percent egg hatch.

Materials and Methods:

Eggs for the incubation trials will be collected from a ripe female captured in the Hudson River during spawning season of 1994. The female will be spawned at NEFC using Common Carp Pituitary injections to induce ovulation. All eggs removed will be placed into stainless steel bowls in ovarian fluid and composited to achieve a uniform quality of spawn. Total spawn removed will be subdivided into equal lots volumetrically. Egg lots will be treated with one of three deadhesion techniques: (1) Fuller's earth by hand mixing (2) Fuller's earth automatic mixing (3) Urea/tannic acid. Three different incubation temperatures (18, 21, and 24E C) will be tested. In addition, three disinfection treatments will be used: (1) iodophor (2) hydrogen peroxide (3) formalin. Once experimental treatments have been administered, water temperature will be ramped up to 24E C over a one-hour period at which time individual banks of hatching jars will be mixed with ambient water to obtain desired incubation temperature. When hatching is completed, fry from each jar will be enumerated to determine the percent hatch. Data collected on each treatment will be analyzed using SAS statistical package ANOVA (GLM). The level of significance used in all statistical tests will be 5%.

Results

1. A significantly greater percent mean hatch ($P < 0.05$) was achieved at 21 (10.1%) and 24EC (8.5%) vs 18E (3.9%).
2. No significant differences in percent hatch were found between deadhesion or disinfection techniques ($P > 0.05$).

Study Number and Title

L-95-03 Comparison of use of LHRHa and CCP for synchronization of gonadal development in Atlantic Salmon (SALMO SALAR).

Principle Investigator: Catharine Johnson, Northeast Fishery Center (NEFC)

Co-Invest/Cooperators: Victor Segarich, Bob Groton - Nashua National Fish Hatchery (NFH); Bill Krise, Dale Holyfield; National Biological Survey (NBS) - Wellsboro; Mike Hendrix, Bill Fletcher, Jerre Mohler - NEFC

Background and Justification:

Atlantic salmon restoration is the highest priority program in Region 5 with a major requirement of the program being successful spawning of adult fish. In 1993, Nashua NFH male domestic salmon did not provide viable gametes in synchronization with female fish thus affecting 1:1 sex ratio required to enhance genetic diversity. In addition, the quality of milt produced was questioned by culturists at the Nashua facility. A management tool was necessary to synchronize the gonadal development ensuring that sufficient male gametes were available at the appropriate time to permit paired matings.

Luteinizing Hormone Releasing Hormone analogue (LHRHa) and Common Carp Pituitary Hormone (CCP) have both been used to induce maturation in Atlantic salmon. Previous study showed that LHRHa could be use in timing of spermiation for gaining higher sperm production. Injection of CCP is also known to induce spermiation in Atlantic salmon.

Study Objective:

Time of spermiation, milt volume, and sperm counts will be determined in three groups of fish receiving either LHRHa, CCP, or injection of saline solution (controls). Performance will be compared between the groups and recommendations made to Nashua personnel.

Materials and Methods:

Sixty three (63) 2+ year male domestic Atlantic salmon from Nashua NFH with little or no milt will be selected for this experiment. Fish will be injected with 1 ml stock solution of either CCP, LHRHa, or sterile saline using a tuberculin syringe and 20-gauge needle. All injections will be administered intramuscularly in the dorsal sinus area adjacent to the dorsal fin. Seven days after the first injection, all males will be checked for milt volume. The quality of milt will be determined with a sperm count and motility score in pools of seven fish.

For each group, milt from 7 fish pools will be used to fertilize pooled eggs from 3 females. Eggs will be divided into aliquots of approximately 500 eggs each. One ml. of milt from each of the pooled males will then be used to fertilize each 500 egg aliquot. There will be 3 egg replicates for each of the 7-pool males in each of the 3 treatment groups for a total of 27. Eggs will be incubated in randomly selected compartments of Heath incubator trays. Egg mortality records will be maintained by Nashua personnel. At egg eye-up, eggs will be shocked and mortality recorded. Remaining live eggs will be determined by direct count. Total live eggs plus mortality will provide exact egg counts for each replicate.

Results

1. Experiment is ongoing

Study Number and Title:

L-95-02 Comparison of eye-up between green Atlantic salmon (*Salmo salar*) eggs transported to incubation facilities unfertilized with those fertilized prior to transport

Principal Investigators: Bill Fletcher, Mike Hendrix and Jerre Mohler -
Northeast Fishery Center (NEFC)

Co-Invest/Cooperators: Bill Krise, Dale Holyfield - National Biological Survey (NBS) Wellsboro; Cathy Johnson - NEFC; Paul Gaston, Fred Trasko - Green Lake NFH; Larry Lofton - North Attleboro NFH; Tom Nelson, Bruce Jenson - White River NFH; Mickey Novack - Richard Cronin NSS; Vic Segarich, Bob Groton - Nashua NFH

Background and Justification

The Atlantic Salmon Program has recently placed increased emphasis on fry stocking as a restoration tool; this has led to increased demand for quality eggs. Currently, many of the production eggs are spawned at one station and transported for incubation to another hatchery. Eye-ups for Atlantic salmon eggs, transported green and fertilized in gallon jugs, have reached levels exceeding 90 percent; however, in recent years eye-ups have been as low as 60 percent. Since 1989, the NEFC and other U.S. Fish and Wildlife facilities have conducted a number of studies with the aim of improving egg quality. For example, NEFC biologists found significantly greater ($P=0.05$) egg eye-up by delaying fertilization until the eggs had arrived at the incubating facility rather than shipping fertilized eggs (87 vs. 41% respectively)

Study Objectives:

The objective of the present study is to compare percent eye-up on a production scale between Atlantic salmon eggs fertilized prior to transport with those fertilized after transport to incubating facilities.

Methods:

The NEFC spawning team will coordinate spawning activities at the following facilities with the indicated number and type of eggs: Richard S. Cronin NSS (50,000 sea-run and 100,000 domestic broodstock eggs); Green Lake NFH (200,000 captive broodstock eggs); Nashua NFH (200,000 domestic broodstock eggs); North Attleboro (1.5 million kelt eggs and incubation site); and White River NFH (incubation site). Prior to egg take, milt will be collected, pooled and placed in test tubes on ice; motility will be checked. One-half of the eggs from each female spawned will be fertilized with two ml of milt per take and transported in insulated gallon jugs containing water and 200 grams of ice. The second half of the eggs will be placed into plastic bags with ovarian fluid, oxygenated and placed into coolers on a tray that rests on ice. Milt for this group will be transported in test tubes sealed in an oxygenated plastic bag in a cooler. Egg disinfection methods will follow recommendations of the Lamar Fish Health Unit.

For Connecticut River kelts held at North Attleboro NFH, spawning and transport of both fertilized (50%) and unfertilized eggs (50%) to White River NFH (via R.S. Cronin NSS) for incubation will occur on multiple dates and will be conducted by hatchery personnel from these three stations. For Richard S. Cronin NSS sea-run broodstock, eggs collected from approximately 10 females will be pooled. Eggs will be split into six groups; three for fertilization at R.S. Cronin NSS and three for fertilization at the incubating facility - White River NFH. Methods for milt handling, fertilization, transport, and disinfection will proceed as described for domestic broodstock trials.

Mean percent eye-up of egg treatments will be compared with 2 sample t-tests.

Results

1. Experiment is in progress.

Study Number and Title:

L-94-10 Proceedings of the Atlantic salmon workshop - Rockport, Maine; 1993

Principle author: U.S. Fish and Wildlife Service, Northeast Fishery Center,
Lamar, Pennsylvania.

Background

The U.S. Fish and Wildlife Service in cooperation with fishery agencies of the New England states, proposes to restore self-sustaining populations of Atlantic salmon by the year 2021 A.D. to much of the species historical range in New England. The restoration effort has it's roots as detailed in Department of the Interior Final Environmental Impact Statement Restoration of Atlantic Salmon to New England (1989), are founded in legal statutes and authorities of no less than 23 planning documents.

Atlantic salmon management methods are continually refined as knowledge of the species and environment expands, therefore a workshop was planned and hosted by the Northeast Fishery Center at the Samoset resort in rockport, Maine. The speakers and subjects discussed were volunteered from the Atlantic salmon scientific community in the Northeast and Pacific Northwest

Objectives

The purpose of this report is to present the proceedings of a workshop that reviewed the latest developments in the culture, management, and research of Atlantic salmon as part of the continuing efforts for successful restoration of the species.

Results

1. Approximately 80 people attended the workshop including people from state, federal, and private enterprise.
2. The report of the proceedings contains 28 presentations on issues of culture, management, research, and fish health as relating to Atlantic salmon

Study Title:

Growth of sub-yearling Atlantic sturgeon at different temperatures and feed rates.

Principal Investigator: Jennifer McPeck, Pennsylvania State University

Co-Invest/Cooperators: Mike Hendrix, Bill Fletcher, Jerre Mohler - Northeast Fishery Center, Lamar, PA.

Background and Justification:

Due to a severe decline in Atlantic sturgeon populations, the Atlantic States Marine Fisheries Commission began development of a management plan for the species in 1988 in order to, among several other objectives, enhance and restore the stock of Atlantic sturgeon. In an effort to achieve this, one of the management recommendations states that expanded aquaculture efforts should be encouraged to develop techniques to rear Atlantic sturgeon and evaluate hatchery fish for stock restoration.

Objectives:

The objective of this study was to determine the optimum conditions for growth and other associated variables (condition factor, etc) with respect to three different temperatures and three different feed rates.

Methods and Materials:

Two trials were conducted during this experiment; one utilizing fish which were six months old and the other utilizing fish which were one month old. Test temperatures were 15, 17, and 19EC. Feed rates (% body weight/day) used for older fish were 0.5, 1.0, or 1.5% while younger fish were offered 3.0, 5.0, or 7.0%. In each trial, three replicates of each temperature and feed rate combination were studied. Approximately 540 fish were utilized in each trial such that an equal biomass was obtained in each tank replicate at the beginning of the experiment. Individual fish weights and lengths were collected at the beginning and end of each trial. Total tank weights were obtained every two weeks to adjust feed rates accordingly. Study durations were 60 days.

Results:

1. Six-month old fish showed that the largest increase in weight occurred at the 3.0% feed rate and 15EC temperature.
2. One-month old fish showed that the largest increase in weight gain occurred at the 7.0% feed rate and 19EC temperature.

Study Title:

Carp Pituitary Hormone Injection of Atlantic Salmon in a net pen aquaculture operation

Principal Investigator: A. Jim Chacko, Atlantic Salmon (Maine) Inc.; Steve Swartz, Kennebec Aquaculture

Co-Invest/Cooperators: Jorn Vad, Atlantic Salmon (Maine) Inc., Bernie Dennison, Kennebec Aquaculture Catharine Johnson, Mike Hendrix - Northeast Fishery Center (NEFC)

Background and Justification:

The Atlantic Salmon net pens on the Machias River were experiencing insufficient amounts of viable milt from males in synchronization with ripe female fish. Carp Pituitary Hormone can be used as a management tool to accelerate the spawning of Atlantic salmon which should shorten the spawning season.

Study Objectives:

Male and female Atlantic salmon will be injected with Carp Pituitary hormone and studied. The volume of milt produced and an evaluation of the egg survival will be made.

Materials and Methods:

The study will take place at the netpens in the Machias River at the Atlantic Salmon (Maine) Inc., Bucks Harbor, Maine. Two hundred fifty males and females will be injected at a rate of 5 mg per kg of body weight. The remainder of the fish in the net pens will serve as controls. The fish will be sorted by sex into separate pens. Three to five fish at a time will be anesthetized with MS-222 prior to intraperitoneal injection with CCP diluted in saline solution. Injected fish will also be tagged prior to their return to the pens. Sperm will be checked for sperm motility.

Results:

1. One hundred and seven males and forty seven females were injected on November 23, 1993. On December 6, 1993 an additional ninety six males were injected.
2. The best results were obtained from injected males; controls yielded only one to two ml. of milt per fish compared to about 40 ml. of milt per fish from the CCP injected fish.
3. The milt was determined to be of good quality with high motility.
4. The female results were inconclusive as to the egg production and accelerated spawning. A significant percentage of mortality was experienced during the initial stages of incubation and during the egg development at the Oquossoc facility. This mortality may be a result of overripe eggs, handling stress, and the water quality at the facility.

Study Title:

Immunomodulators as a fish health management tool

Principal Investigators: Abernathy Salmon Culture Technology Center

Co-Invest/Cooperators: Northeast Fishery Center Biologists - Lamar, Pa

Background and Justification

Furunculosis, a pathogenic disease in salmonids is caused by the bacterium *Aeromonas salmonicida* has been considered a scourge of salmonid culture. The disease has a negative impact on the Atlantic salmon program from holding returning sea-run fish for spawning to maintaining and producing domestic broodstock and smolts. Oxytetracycline has been injected to prevent outbreaks of the disease but is often an impractical means of control.

Study Objectives

This study will test the efficacy of three different diets containing additives for immune system enhancement in prevention of furunculosis in domestic Atlantic salmon parr.

Methods and Materials

Domestic Atlantic salmon parr raised at the Northeast Fishery Center will be used in the study. The diets to be tested are: (1) VST (2) Tetraselmis (3) Levucell, a glucans enriched feed. Fish will be randomly assigned to four holding tanks. All fish will be fed the control diet for 14 days. During the second 14 days, groups will be offered one of the test diets or the control. On day 29, fish will be challenged with a furunculosis bath and placed into replicate experimental holding tanks. During the final three weeks of the study, all groups will receive the control diet. Mortality will be recorded daily for all study tanks.

Results

1. Little mortality occurred in any treatments.
2. Even though *Aeromonas salmonicida* was isolated from challenged fish, the immersion bath may been insufficient in concentration of bacteria to elicit a furunculosis response.

Study Title:

Sex identification of Atlantic sturgeon through molecular techniques

Principal Investigators: Richard Brandon, and Carl Batt - Cornell University

Co-Invest/Cooperators: Northeast Fishery Center; University of Florida; Cornell University; Natl. Fisheries and Wildlife Center - Gainesville, FA; Anadramous Fish Research Center - Turner's Falls, MA

Background and Justification

Initial attempts at gaining sturgeon population data have been frustrating for a number of reasons including determining of sex of captured animals. The sex of sturgeon can only reliably be determined phenotypically when in spawning condition with the expression of milt in the male or abdominal distension from roe in the female. At any other stage of development or life history, sex can only be determined through surgical biopsy. In the field, surgical procedures are time consuming, and a possible threat to the health of the fish. Therefore, a test which could determine fish sex, without requiring invasive techniques would be a valuable tool for monitoring populations among others.

A direct approach to determining sex would be to isolate male-specific DNA originating from the sturgeon genome. This male-specific DNA could then be used as a probe in to devise a relatively simple laboratory assay for sexing individual sturgeon.

Methods and Materials

DNA will be extracted from blood collected from known male and female sturgeon of various origins and additionally from fish of unknown gender. Two methods will be pursued to isolate male-specific DNA: (1) Random Amplification of Polymorphic DNA or RAPD (2) Representational Difference Analysis or RDA. The RAPD process results in the generation of products which can be analyzed by gel electrophoresis and can distinguish between closely related individuals. Furthermore, these products could potentially be manipulated further to reveal gender differences. DNA from male and female sturgeon that have been determined to be closely related through RAPD will be subjected to RDA. This will generate a series of bands representing differences between the genomes. The bands will be cloned and used as probes which will bind to either male or female DNA but not both. Differences may then be discovered that are based upon the individual genotype of the specimen or related to their sex difference.

The DNA sequences which distinguish male and female will then be used to design a PCR reaction which could be linked to a user-friendly colorimetric readout.

Preliminary Results

1. Initial RAPD assays have shown that sturgeon from the Hudson River can be easily differentiated from those captured in North Carolina.
2. One primer has produced a banding pattern difference between Hudson River male and female DNA.

Study Title:

Monitoring stress responses on the reproductive physiology of Atlantic sturgeon

Principal Investigator: William F. Krise, Ph.D.- National Biological Survey - Wellsboro

Co-Invest/Cooperators: Northeast Fishery Center (NEFC) - Lamar; Joel Van Eenennaam - University of California, Davis

Background and Justification

Remnant populations of Atlantic sturgeon (ASN) exist in large eastern U.S. rivers such as the Hudson and Delaware. As part of the restoration efforts on this species, more data is needed on induced spawning and effect of stress related to capture of individuals in the wild. This will allow production of viable spawn for use in management of ASN in the Hudson and other rivers.

Nothing is known about the endocrinological patterns of ASN after induced ovulation, and there has been no monitoring of responses to capture stress to determine the impacts of handling, netting, temperature, and surgical stress on the reproductive physiology of ASN captured when near gonad maturation.

Objectives

Objectives are (1) to monitor the response to capture and handling stress in adult Atlantic sturgeon (2) to monitor levels of sex hormones in wild and captive Hudson river fish once induced to spawn. Egg viability will also be monitored.

Results

1. Work is ongoing

Studies Planned for FY95

Atlantic salmon:

- Follow-up study for using hormones to time spermiation in Atlantic salmon broodstock at Nashua NFH.
- Follow-up study on results of Atlantic salmon egg transport testing delayed vs. immediate fertilization at full production levels.
- Repeat study for using immuomodulators for preventing furunculosis in spring Atlantic salmon smolts.
- Atlantic salmon fry marking studies.

Atlantic sturgeon:

- Capture and induced spawning of mature Delaware River and/or Hudson River Atlantic sturgeon
- Influence of available feeding substrate on growth of Atlantic sturgeon fry
- Influence of feeding regimes on growth of juvenile Atlantic sturgeon
- Initiation of feeding in captive Atlantic sturgeon using formulated diets
- Hormone induction of spermiation in male Atlantic sturgeon held in captivity since 1991
- Cooperation with U.C. Davis in challenging Atlantic sturgeon to known white sturgeon viruses
- Cooperation with National Biological Survey - Leetown in challenging Atlantic sturgeon to known salmonid pathogens
- Cooperation with University of Georgia, Coastal Plain Experiment Station to test control of *Dero digitata* populations in catfish ponds as a means of reducing PGD (hamburger gill disease) in cultured catfish
- Cooperation with National Biological Survey - Leetown to determine strontium otolith mark as indication of age for seaward migration of Atlantic sturgeon
- Cooperation with National Biological Survey - Leetown on studies of winter behavior and habitat selection of young-of-the-year Atlantic sturgeon

Miscellaneous:

- Cooperation with Aquatic Systems Engineering and Electric Power Research Institute (EPRI) on Effects of daily fluctuating dissolved Oxygen levels on growth of various fish species.
- Initial establishment of various species of hydrophytes seeded into a constructed wetland